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$$H:R::R:R-h \text{ or } H=R_1/2.$$

Now by the law of gravitation,  $(R_1/2)^2:R^2::150:x$ , the required weight, that is,  $x=\frac{150R^2}{2R^2}=75$ .

112. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pa.

Vary the radius of curvature of a plane curve inversely as the abscissa; then the solution will give you, (1) Ryan's Equation of the Elastic Curve, and (2) Wood's Equation of the Hydrostatic Curve.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$$\text{Radius of curvature} = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}} = \frac{a^2}{2x}.$$

$$\therefore a^2(d^2y/dx^2) = 2x[1 + (dy/dx)^2]^{\frac{3}{2}}. \quad \text{Let } dy/dx = p.$$

$$\therefore a^2(dp/dx) = 2x(1+p^2)^{\frac{3}{2}} \text{ or } a^2p/\sqrt{1+p^2} = (x^2+A).$$

$$\therefore p = dy/dx = \pm \sqrt{(x^2+A)}/\sqrt{a^4-(x^2+A)^2}. \quad \text{Let } x^2+A = a^2\cos\theta.$$

$$\therefore y = \mp \frac{1}{2}a^2 \int \frac{\cos\theta d\theta}{\sqrt{(a^2\cos\theta-A)}} = \mp \frac{1}{2}a^2 \int \frac{(1-2\sin^2\frac{1}{2}\theta)d\theta}{\sqrt{(a^2+1-A-2\sin^2\frac{1}{2}\theta)}}.$$

$$\text{Let } \frac{1}{2}\theta = \varphi \text{ and } 2/(a^2+1-A) = e^2.$$

$$\therefore y = \pm \frac{a^2e^2}{2} \int \frac{(1-2\sin^2\varphi)d\varphi}{\sqrt{(1-e^2\sin^2\varphi)}}.$$

$$\therefore y = \pm a^2E(e, \varphi) \mp (\frac{1}{2}a^2)(2-e^2)F(e, \varphi) + B \dots (1).$$

$$\text{Since } \varphi = \frac{1}{2}\theta, y = \pm a^2E(e, \frac{1}{2}\theta) \mp (\frac{1}{2}a^2)(2-e^2)F(e, \frac{1}{2}\theta) + B \dots (2).$$

(1) represents Ryan's Elastic Curve and (2) represents the Hydrostatic Curve. In the above  $e < 1$  and  $A < a^2 + 1$ .

In the second equation the curve can never cross the line of force since  $\sin(\frac{1}{2}\theta)$  cannot equal  $1/e$ .

Also solved by J. SCHEFFER.

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## DIOPHANTINE ANALYSIS.

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58. Proposed by JOHN M. COLAW, A. M., Monterey, Va.

Find a square proper fraction which if subtracted from unity will leave for remainder a square proper fraction.

I. Solution by C. E. ARMENTROUT, Professor of Mathematics, Rockingham Military Institute, Mt. Crawford, Va.; G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa.; and P. S. BERG, Larimore, N. D.

Let  $(y/x)^2$  be the square proper fraction.

$$1 - (y/x)^2 = (n/m)^2 \text{ or } m^2(x^2 - y^2) = n^2x^2.$$

$$\text{Let } x = p^2 + q^2, y = p^2 - q^2.$$

$$\therefore 1 - \left( \frac{p^2 - q^2}{p^2 + q^2} \right)^2 = \frac{4p^2q^2}{(p^2 + q^2)^2}, \text{ where } p \text{ can be any value greater than } q.$$

$$\text{Let } p=2, q=1. \quad \therefore 1 - \left( \frac{3}{5} \right)^2 = \left( \frac{4}{5} \right)^2.$$

$$\text{Let } p=3, q=2. \quad \therefore 1 - \left( \frac{5}{13} \right)^2 = \left( \frac{24}{13} \right)^2.$$

II. Solution by M. A. GRUBER, A. M., War Department, Washington, D. C., and COOPER D. SCHMITT, A. M., University of Tennessee, Knoxville, Tenn.

This reduces to the simple statement that  $a^2/c^2 + b^2/c^2 = 1$ , or that  $a^2 + b^2 = c^2$ . This is evidently satisfied in the case of every rational right triangle.

$$\text{Thus, } 3^2 + 4^2 = 5^2, \text{ or } \frac{9}{25} + \frac{16}{25} = 1.$$

This is the same as saying  $1 - \frac{9}{25} = \frac{16}{25}$ , thus fulfilling the condition of the problem.

Similarly an indefinite number of examples might be given.

Also solved by J. H. DRUMMOND, ALOIS F. KOVARIK, J. W. YOUNG, and the late SYLVESTER ROBINS.

86. Proposed by A. H. BELL, Hillsboro, Ill.

The edges of a rectangular parallelopiped are within one of the proportion 3:6:7, and if they are  $3x$ ,  $6x \mp 1$ ,  $7x$ , then  $(3x)^2 + (6x \mp 1)^2 + (7x)^2 = \text{the diagonal squared} = 94x^2 \mp 12x + 1 = \square$ . To find four integral values for  $x$  in this equation.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$$\text{Let } 94x^2 \mp 12x + 1 = (mx \mp 1)^2 = m^2x^2 \mp 2mx + 1.$$

$$\therefore x = \pm \frac{2(m-6)}{94-m^2}.$$

Expanding  $\sqrt{94}$  as a continued fraction we get

$$\sqrt{94} = 9 + \frac{1}{1 + \frac{1}{2 + \frac{1}{3 + \frac{1}{1 + \frac{1}{1 + \frac{1}{5 + \frac{1}{1 + \frac{1}{8 + \frac{1}{1 + \frac{1}{5 + \frac{1}{1 + \frac{1}{1 + \frac{1}{3 + \frac{1}{2 + \frac{1}{1 + \frac{1}{9 +}}}}}}}}}}}}}}}}}}}}}}}$$

The successive convergents are as follows :

$$\frac{9}{1}, \quad \frac{10}{1}, \quad \frac{29}{3}, \quad \frac{97}{10}, \quad \frac{126}{13}, \quad \frac{223}{23}, \quad \frac{1241}{128}, \quad \frac{1644}{151}, \quad \frac{12953}{1336}, \quad \frac{14417}{1487},$$

$$\frac{85038}{8771}, \quad \frac{99455}{10258}, \quad \frac{184493}{19029}, \quad \frac{652934}{67345}, \quad \frac{1490361}{1537191}, \quad \frac{2143295}{221064}, \quad \dots \dots$$